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无线视频质量的评测理论及方法研究

Theories and Methods for Wireless Video Quality Assessment

袁 飞

指导教师姓名: 姚 彦 教 授

专 业 名 称: 通信与信息系统

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摘 要

无线视频质量的检测和评价技术是保障新一代网络服务质量的关键技术之一,可应用在无线视频系统的方案设计、产品对比以及业务监控等诸多领域,一直备受业界关注。然而,目前视频质量的自动评测是一个还没得到满意解决、且富有挑战性的课题。尤其在面向无线应用的视频质量客观评测中,由于无线传输的诸多特点,使得传统评测技术更加捉襟见肘。本论文以视频质量评价技术的无线应用为背景,旨在探索适合无线应用特点,且具有较好评测性能的视频质量自动评测方法。

论文首先系统整理了人眼视觉系统(HVS)的生理机制及其在视频质量感知和评价中的作用。其次,论文全面研究和总结了当前视频质量评测的技术现状和理论方法。从“离线”和“在线”两大应用角度对现有理论和方法进行细化分类,重点探讨了评测模型在无线应用中的优缺点及其前景和趋势。接着,作者构建了无线视频质量综合仿真及分析平台,通过不同类型的视频及图像的质量仿真及分析,积累了无线视频的劣化特点和主要影响规律。然后,在上述研究的基础上,结合无线视频的活动性规律和视频质量的空-时域分析模型,创新性地提出了基于“内容预检测”和“活动性分区”的无线视频质量评测机制。通过“活动性分区”,可实现“因材施教”的评测机制,即根据各活动区的自身特点,有差别的配置合适的检测参数和评价机制;通过“内容预检测”,可实现真正意义的空-时域联合检测,即充分利用预检测获得的空-时域信息,指导和调控相应特征的检测精度和评价策略。最后,针对无线视频“离线”和“在线”两大应用背景,探讨评测模型的无线应用策略,并实现模型检测参数与主观质量间的相似性映射。

在上述理论和方法研究的基础上,论文基于“视频质量专家组”(VQEG)对评测模型性能的四项测度,对本评测模型的性能进行测试及验证。通过与其他相关模型的性能对比,证明本模型具有较好的主观相似性,且在无线视频质量的评测应用中具有一定的优势,达到了本研究的预期目标。

关键词: 视频质量; 客观评价; 无线视频

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Abstract

It is pivotal for the new generation of wireless network to evaluate its video quality. Video quality assessment can be widely used in the designing, comparing and application of the communication systems. So it attracts great interest of researchers. However, it is still an unsatisfied and challenging subject for people to evaluate the quality of a digital video. Due to its characteristic, traditional methods which can be used are not suitable for wireless application. This paper based on the characteristic of the wireless application and aimed to find the suitable method to evaluate the quality of video.

Firstly, the paper introduced the physiological and psychological mechanism of the human visual system (HVS) which played an important role in video and image processing technology. Secondly, the paper systemically analyzed the current theories and methods for the video quality assessment and classified them into off-line-mode and on-line-mode based on their wireless application. By doing so, it would be more visible to find out the advantage or disadvantage of the current theories and methods in their wireless application. Then a general simulation and analysis platform was founded to help the author accumulate all kinds of distorted videos and discover the main factors which contribute to the influence of the video quality. Thus a new model which based on the principle of so call content-pre-detection and activity-division was proposed for the wireless video quality evaluation. By doing activity-division, it would be possible for the system to choose the suitable strategy for the quality evaluation according to the different characteristic of the different video activity regions. While by doing the content-pre-detection, it would be able to take good use of the spatial and temporal information and combine them to guide the strategy for the video quality assessment. Finally, the paper discussed two types of wireless application of the model which were on-line-mode and off-line-mode, and builded a relationship to map the parameters to the subjective score.

Following the research above, the paper used the four metrics which proposed

by the VQEG (Video Quality Expert Group) to test and validate the performance of the model. By comparing it to other models, it is proved to have better relationship with the subjective score and have more predominance to be used in the wireless application.

Key words: Video Quality, Objective Assessment, Wireless Video

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